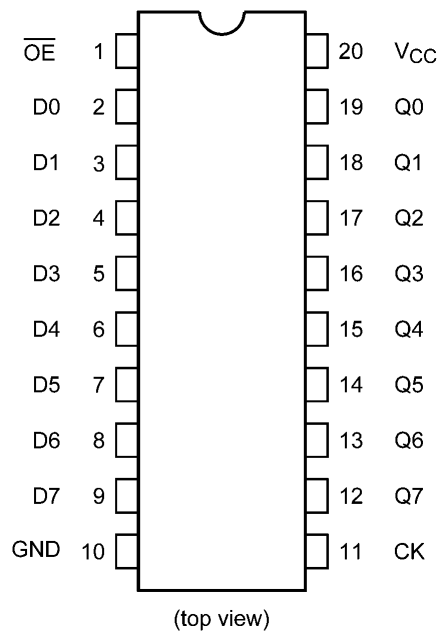
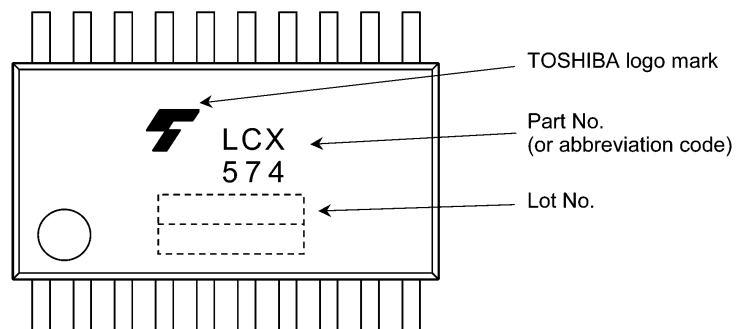


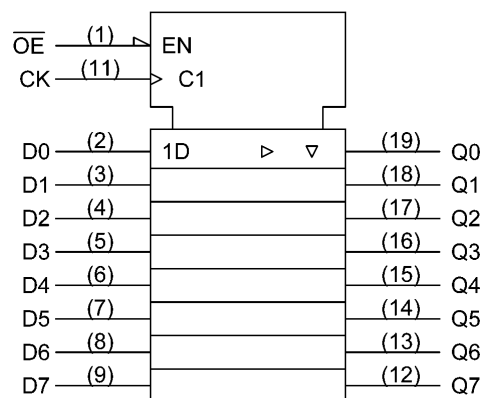
5. Pin Assignment






6. Marking



7. IEC Logic Symbol

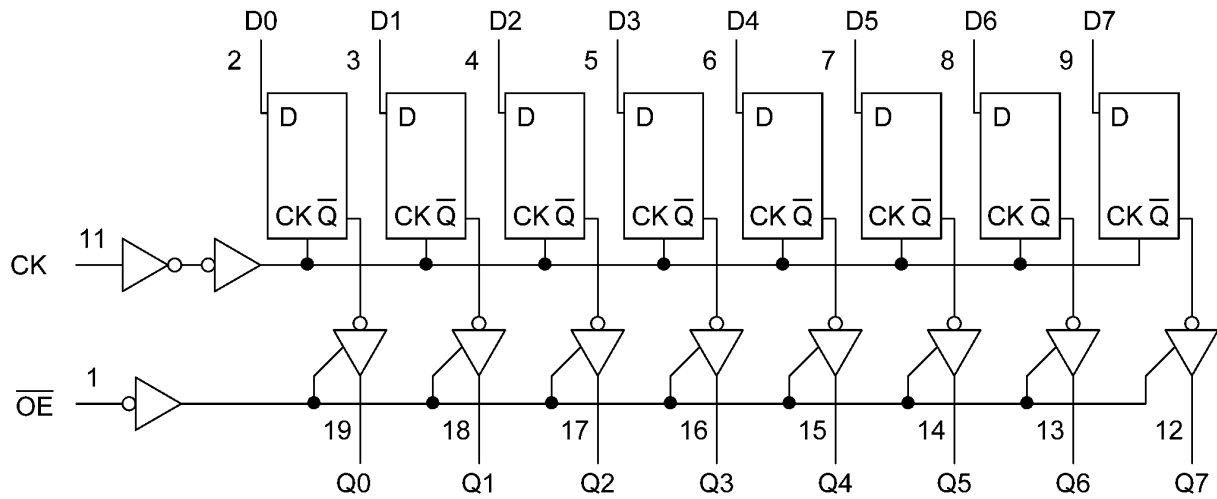


8. Truth Table

Inputs			Outputs
\overline{OE}	CK	D	
H	X	X	Z
L		X	Q_n
L		L	L
L		H	H

X: Don't care
 Z: High impedance
 Q_n : No change

9. System Diagram



10. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		-0.5 to 6.5	V
Input voltage	V_{IN}		-0.5 to 6.5	V
Output voltage	V_{OUT}	(Note 1)	-0.5 to 6.5	V
		(Note 2)	-0.5 to $V_{CC} + 0.5$	
Input diode current	I_{IK}		-50	mA
Output diode current	I_{OK}	(Note 3)	± 50	mA
Output current	I_{OUT}		± 50	mA
Power dissipation	P_D		180	mW
V_{CC} /ground current	I_{CC}/I_{GND}		± 100	mA
Storage temperature	T_{stg}		-65 to 150	$^{\circ}C$

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: Output in OFF state.

Note 2: High (H) or Low (L) state. I_{OUT} absolute maximum rating must be observed.

Note 3: $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

11. Operating Ranges (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		1.65 to 3.6	V
		(Note 1)	1.5 to 3.6	
Input voltage	V_{IN}		0 to 5.5	V
Output voltage	V_{OUT}	(Note 2)	0 to 5.5	V
		(Note 3)	0 to V_{CC}	
Output current	I_{OH}, I_{OL}	(Note 4)	± 24	mA
		(Note 5)	± 12	
Operating temperature	T_{opr}		-40 to 85	$^{\circ}C$
Input rise and fall times	dt/dv	(Note 6)	0 to 10	ns/V

Note: The operating ranges must be maintained to ensure the normal operation of the device.

Unused inputs must be tied to either V_{CC} or GND.

Note 1: Data retention only.

Note 2: Output in OFF state.

Note 3: High or low state

Note 4: $V_{CC} = 3.0$ to 3.6 V

Note 5: $V_{CC} = 2.7$ to 3.0 V

Note 6: $V_{IN} = 0.8$ to 2.0 V , $V_{CC} = 3.0$ V

12. Electrical Characteristics

12.1. DC Characteristics (Unless otherwise specified, $T_a = -40$ to $85\text{ }^\circ\text{C}$)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit	
High-level input voltage	V_{IH}	—	1.65 to 2.3	$V_{CC} \times 0.9$	—	V	
			2.3 to 2.7	1.7	—		
			2.7 to 3.6	2.0	—		
Low-level input voltage	V_{IL}	—	1.65 to 2.3	—	$V_{CC} \times 0.1$		
			2.3 to 2.7	—	0.7		
			2.7 to 3.6	—	0.8		
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100\text{ }\mu\text{A}$	1.65 to 3.6	$V_{CC} - 0.2$	—	V
			$I_{OH} = -4\text{ mA}$	1.65	1.05	—	
			$I_{OH} = -8\text{ mA}$	2.3	1.7	—	
			$I_{OH} = -12\text{ mA}$	2.7	2.2	—	
			$I_{OH} = -18\text{ mA}$	3.0	2.4	—	
			$I_{OH} = -24\text{ mA}$	3.0	2.2	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 100\text{ }\mu\text{A}$	1.65 to 3.6	—	0.2	
			$I_{OL} = 4\text{ mA}$	1.65	—	0.45	
			$I_{OL} = 8\text{ mA}$	2.3	—	0.7	
			$I_{OL} = 12\text{ mA}$	2.7	—	0.4	
			$I_{OL} = 16\text{ mA}$	3.0	—	0.4	
			$I_{OL} = 24\text{ mA}$	3.0	—	0.55	
Input leakage current	I_{IN}	$V_{IN} = 0$ to 5.5 V	1.65 to 3.6	—	± 5.0	μA	
3-state output OFF-state leakage current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0$ to 5.5 V	1.65 to 3.6	—	± 5.0	μA	
Power-OFF leakage current	I_{OFF}	$V_{IN}/V_{OUT} = 5.5\text{ V}$	0	—	10.0	μA	
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND	1.65 to 3.6	—	10.0	μA	
		$V_{IN}/V_{OUT} = 3.6$ to 5.5 V	1.65 to 3.6	—	± 10.0		
Quiescent supply current	ΔI_{CC}	$V_{IH} = V_{CC} - 0.6\text{ V}$ (per input)	2.7 to 3.6	—	500		

12.2. AC Characteristics (Unless otherwise specified, $T_a = -40$ to 85 °C)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	Min	Max	Unit
Maximum clock frequency	f_{MAX}		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.1, Table 12.6.1	1.8 ± 0.15	50	—	MHz
				2.5 ± 0.2	100	—	
				2.7	100	—	
				3.3 ± 0.3	150	—	
Propagation delay time (CK-Q)	t_{PLH}, t_{PHL}		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.1, Table 12.6.1	1.8 ± 0.15	—	30.0	ns
				2.5 ± 0.2	—	10.5	
				2.7	—	9.5	
				3.3 ± 0.3	1.5	8.5	
Output enable time	t_{PZL}, t_{PZH}		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.2, Table 12.6.1	1.8 ± 0.15	—	34.0	ns
				2.5 ± 0.2	—	17.0	
				2.7	—	9.5	
				3.3 ± 0.3	1.5	8.5	
Output disable time	t_{PLZ}, t_{PHZ}		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.2, Table 12.6.1	1.8 ± 0.15	—	28.0	ns
				2.5 ± 0.2	—	14.0	
				2.7	—	7.0	
				3.3 ± 0.3	1.5	6.5	
Minimum pulse width(CK)	$t_{w(L)}, t_{w(H)}$		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.1, Table 12.6.1	1.8 ± 0.15	10.0	—	ns
				2.5 ± 0.2	5.0	—	
				2.7	3.3	—	
				3.3 ± 0.3	3.3	—	
Minimum setup time	t_s		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.1, Table 12.6.1	1.8 ± 0.15	10.0	—	ns
				2.5 ± 0.2	5.0	—	
				2.7	2.5	—	
				3.3 ± 0.3	2.5	—	
Minimum hold time	t_h		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.1, Table 12.6.1	1.8 ± 0.15	1.5	—	ns
				2.5 ± 0.2	1.5	—	
				2.7	1.5	—	
				3.3 ± 0.3	1.5	—	
Output skew	t_{osLH}, t_{osHL}	(Note 1)	—	2.7	—	—	ns
				3.3 ± 0.3	—	1.0	

Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLHm} - t_{PLHn}|$, $t_{osHL} = |t_{PHLm} - t_{PHLn}|$)

12.3. Dynamic Switching Characteristics (Unless otherwise specified, $T_a = 25$ °C, Input: $t_r = t_f = 2.5$ ns, $C_L = 50$ pF, $R_L = 500$ Ω)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Unit
Quiet output maximum dynamic V_{OL}	V_{OLP}	$V_{IH} = 3.3$ V, $V_{IL} = 0$ V	3.3	0.8	V
Quiet output minimum dynamic V_{OL}	$ V_{OLV} $	$V_{IH} = 3.3$ V, $V_{IL} = 0$ V	3.3	0.8	V

12.4. Capacitive Characteristics (Unless otherwise specified, $T_a = 25$ °C)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	Typ.	Unit
Input capacitance	C_{IN}		—	3.3	7	pF
Output capacitance	C_{OUT}		—	3.3	8	pF
Power dissipation capacitance	C_{PD}	(Note 1)	$f_{IN} = 10$ MHz	3.3	25	pF

Note 1: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation.

$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8 \text{ (per bit)}$$

12.5. AC Test Circuit

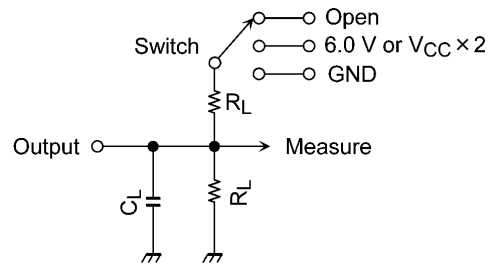


Table 12.5.1 Parameter for AC Test Circuit

Parameter	Switch	Test Condition
t _{PLH} , t _{PHL}	OPEN	—
t _{PLZ} , t _{PZL}	6.0 V	V _{CC} = 3.3 ± 0.3 V
		V _{CC} = 2.7 V
	V _{CC} × 2	V _{CC} = 2.5 ± 0.2 V
		V _{CC} = 1.8 ± 0.15 V
t _{PHZ} , t _{PZH}	GND	—
t _w , t _s , t _h	OPEN	—

12.6. AC Waveform

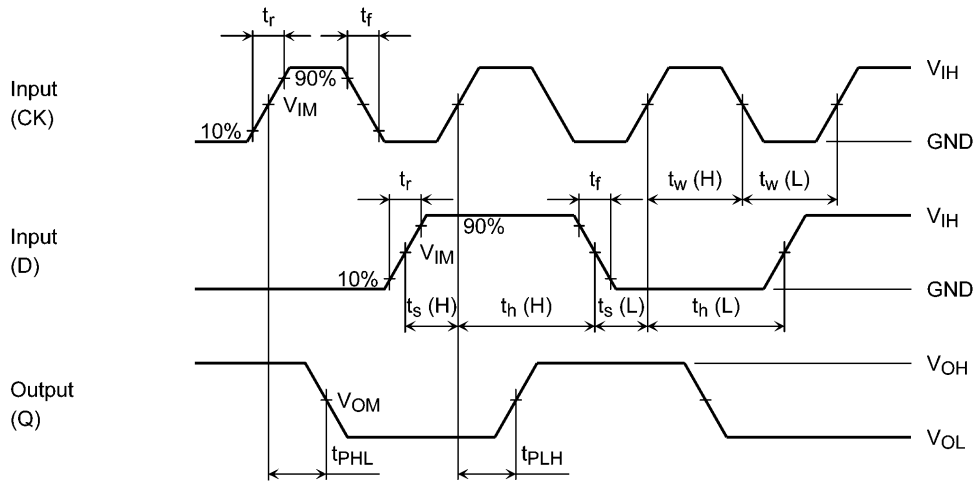


Fig. 12.6.1 t_{PLH} , t_{PHL} , t_w , t_s , t_h

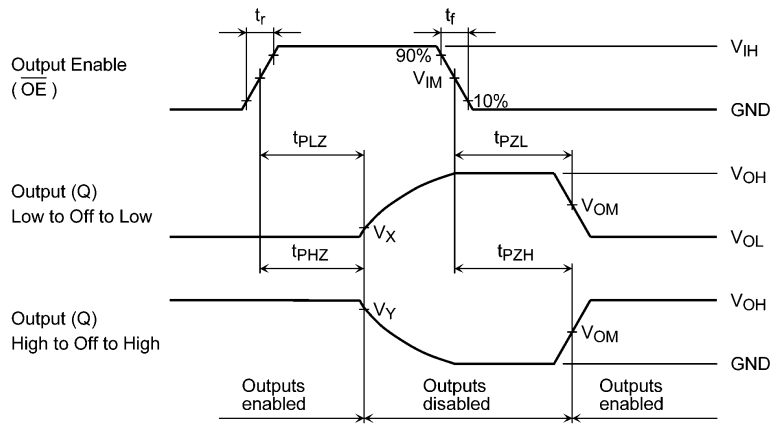


Fig. 12.6.2 t_{PLZ} , t_{PHZ} , t_{PZL} , t_{PZH}

Table 12.6.1 AC Waveform Symbols

	Symbol	$V_{CC} = 3.3 \pm 0.3 \text{ V}$ $V_{CC} = 2.7 \text{ V}$	$V_{CC} = 2.5 \pm 0.2 \text{ V}$	$V_{CC} = 1.8 \pm 0.15 \text{ V}$
Input	V_{IH}	2.7 V	V_{CC}	V_{CC}
	V_{IM}	1.5 V	$V_{CC}/2$	$V_{CC}/2$
	t_r, t_f	2.5 ns	2.0 ns	2.0 ns
Output	V_{OM}	1.5 V	$V_{OH}/2$	$V_{OH}/2$
	V_X	$V_{OL} + 0.3 \text{ V}$	$V_{OL} + 0.15 \text{ V}$	$V_{OL} + 0.15 \text{ V}$
	V_Y	$V_{OH} - 0.3 \text{ V}$	$V_{OH} - 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
Load	C_L	50 pF	30 pF	30 pF
	R_L	500 Ω	500 Ω	1 k Ω

Package Dimensions

Unit: mm



Weight: 0.071 g (typ.)

Package Name(s)
Nickname: TSSOP20B

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